Knowledge crossing boundaries

Souza da Conceição, Carolina; Jensen, Anna Rose Vagn; Broberg, Ole

Publication date:
2016

KNOWLEDGE CROSSING BOUNDARIES

How to improve the design of offshore units
by transferring knowledge from operations

DTU

You can find this booklet and
the scientific outcome of the project at
www.edgeproject.dk

ABOUT THIS BOOKLET

The challenge of knowledge transfer from operations to the design of new offshore units is of particular importance in the maritime sector. This is due to the geographical separation of offshore operations and the onshore engineering design of new units, whether it is of rigs, ships or other units. Throughout this booklet, we use the term 'rig' as an example of an offshore unit. The term rig will be used to illustrate the challenges and solutions regarding ways of capturing operational experiences and ideas and transferring them to the design process of new rigs.

The booklet has a specific point of departure: Designers of rigs need systematic feedback involving knowledge and ideas from the rig personnel to optimise the design of new rigs. From this starting point, the booklet introduces models and tools to address the following challenge: How can this feedback be accomplished when the designers rarely or never go to see the work onboard a rig?

We frame the knowledge transfer challenge in a new way that offers conceptual ideas, tools and methods to improve the transfer and benefit from it. The booklet connects a four-step process model with a work systems approach to knowledge transfer. The rig is seen as a work system and the design team of a new rig is seen as another work system. Hence, the challenge is how to capture and transfer experiences and ideas from the rig work system to the design team work system.

The booklet targets top management, CTOs and project managers in oil and gas companies, oil drilling companies, and shipping industries.

Carolina Souza da Conceição
Anna Rose Vagn Jensen
Ole Broberg

Technical University of Denmark
DTU Management Engineering
Engineering Systems Division

"So the whole thing is about constant improvements, capturing lessons learned and using those lessons learned to improve the future."

Performance coach

WHAT IS IN THIS BOOKLET?

WHY KNOWLEDGE TRANSFER?

WHAT IS THE PROBLEM?

WHAT YOU WANT TO PREVENT

If the knowledge transfer from operations to engineering design does not work properly, companies may experience:

- Rig designs that need to be altered at a high cost after starting operations
- Costly design flaws that are repeated in new rigs
- Rig designs that reduce the efficiency of the operations personnel
- 'Over-engineered' design solutions that could be solved more cheaply and by simpler means
- Safety and work environment issues
- Down-time due to equipment that does not work properly
- Reduced customer value

WHAT IT TAKES

If you want to address these issues, they have to be dealt with at several layers in the organisation.

Knowledge transfer is a matter of strategic knowledge management in the company. At a general level, some basic steps are needed to improve the knowledge transfer:

- State the strategic goals of knowledge transfer from operations to the design of new rigs
- Map the current methods and the efficiency of knowledge transfer
- Develop appropriate methods and tools for improving the transfer
- Adjust policies and procedures to match the strategy across all levels in the organisation
- Apply the body of experiences and knowledge from operations to the design of new rigs

"To save money we involve the end users too late, and I think this has cost us a huge amount of money."

Rig section leader

HOW TO MANAGE KNOWLEDGE TRANSFER?

THE KNOWLEDGE TRANSFER FRAMEWORK

The starting point when dealing with knowledge transfer is to have a knowledge management strategy.

A good approach is first understanding knowledge transfer and what it takes. It can be seen as a process, since knowledge transfer is more complex than mere ‘pieces of information’ that can be transferred immediately without being transformed.

The knowledge generated from the experience of people engaged in operational tasks and activities needs to be captured and transformed into knowledge that can cross the boundaries to reach the engineering design teams onshore.

The entire process requires a continuous flow in order to develop a permanent repository that is continuously updated and is used to optimise the design.

Structuring the knowledge transfer process provides a better idea of what is involved. However, before going further, another important point is understanding who generates and registers the knowledge, and who is intended to receive and retrieve it.

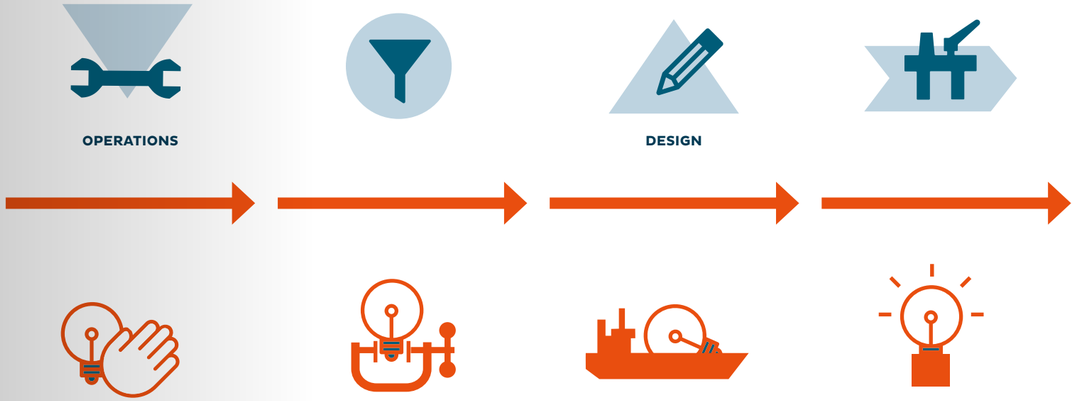
This communication model depicts the main idea behind the knowledge transfer. The operating rig is the sender of knowledge in form of inputs and ideas through formal and informal channels such as information and communication technology (ICT) systems, e-mails or other means of communication. The design team is the receiver of this knowledge. Furthermore, the design team is also the retriever of knowledge that is not sent directly to it, but is registered in one of the systems by the operating rig.

Examples of operational knowledge offshore personnel can contribute:

- Practical knowledge, such as issues with storage space for large machinery leading to storage in unplanned spaces, or issues with drains in bad positions causing drainage problems
- Specific knowledge, such as equipment that has more functionalities than necessary, leading to additional working hours for maintenance and unnecessary costs

The knowledge transfer process is done in four steps. The knowledge must be captured from the rigs, then transformed and transferred to the design team, following which it should be applied in new projects.

KNOWLEDGE TRANSFER IN FOUR STEPS



CAPTURING KNOWLEDGE

Generating and capturing potential knowledge from the experiences of the rig personnel that can be structured afterwards, including practical and specific knowledge embodied in their work activities.

TRANSFORMING KNOWLEDGE

Transforming this knowledge for use in the engineering design context. It must be systematised and translated in order to have value for improving design solutions.

TRANSFERRING KNOWLEDGE

Transferring this knowledge via suitable mechanisms, including storage in a computer-based repository with easy-to-retrieve features, pictures, sketches and statistics.

APPLYING KNOWLEDGE

Directing the knowledge to the right designers and applying it throughout the design process, including external participants, such as vendors and shipyards.

TWO DIFFERENT WORK SYSTEMS

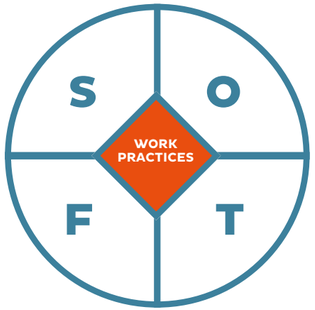
The rig and the design team can be seen as two distinct work systems separated by the sea.

A work system may be seen as having four interdependent elements: space, organisation, finance and technology (SOFT). The work performed by the rig personnel is embedded in these four elements. The configuration of the elements affects how the individuals perform their work practices, and influences the overall features of the system such as safety and performance.

The outcome of a work system is a product or service. The operations work system produces wells, oil or gas, and the design work system produces design specifications for a new rig in order for a shipyard to build it.

The work systems have different perspectives and key performance indicators (KPI). This might be a challenge when capturing knowledge and transferring it from the rig operations to the design process of new rigs. There are some boundaries between the two work systems that need to be crossed.

THE SOFT MODEL OF A WORK SYSTEM



Safety & Performance

(depending on the configuration of elements)

“The people sitting in the design team don’t have a lot of operations knowledge, because they are not in the operations.”

Rig worker participating in the project team

Understanding the different characteristics of each work system makes it easier to set up the strategies necessary for the knowledge transfer process.

The work system model also helps to identify and systematise the types of operational knowledge that could be valuable for the design team.

THE OPERATIONS WORK SYSTEM

WORK PRACTICES

The offshore work system is where operations take place. This is a highly complex, and sometimes hostile environment, creating a unique working environment for the rig personnel.

During their daily work, the rig personnel will experience how the four elements and the interaction thereof will make their work practices easier or more difficult. Such experiences also generate ideas regarding ways to improve the design, or at least highlight limitations preventing the rig personnel from doing their jobs properly. The KPIs for this work system are not normally aimed at transferring operational knowledge to the design teams.

CHALLENGES

The challenge is to determine the type of knowledge that is valuable for the design team. Many operational issues are to be solved in the operations work system. Other issues are to be reported to the design team in order to improve the design of a new rig.

On the practical side, if there are problems with storing spare parts, finding a new storage area and relocating spare parts should be resolved on the operating rig. However, the lack of storage space should be reported to the design team. More specifically, if it is necessary to repair or replace malfunctioning equipment, this should be done on the operating rig; however, if the equipment needs to be changed because it is inappropriate, this should be reported to the design team.

> **“I feel we have a lot to give from the operations side.”**
>
> Rig worker participating in the project team

THE DESIGN WORK SYSTEM

WORK PRACTICES

The onshore work system is where the design of new rigs takes place. The design process is complex and iterative, involving several phases and many different disciplines and specialists, including the shipyard and vendors. The work is project-based, and specific design teams are formed. This work system has its own KPIs, which do not necessarily include taking experiences and ideas that are generated in the operations work system into account.

CHALLENGES

The challenge is to motivate the design team to retrieve operational knowledge while working on other tasks and under great time pressure. Furthermore, the design team has to interact with the shipyard and vendors to align costs and customer value.

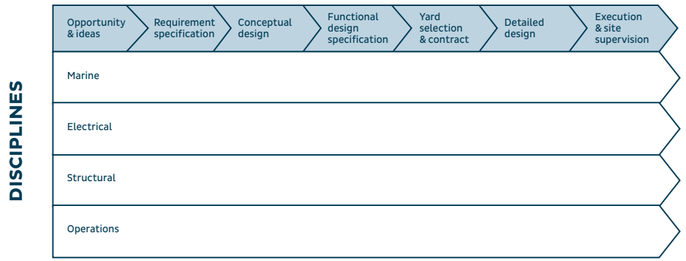
Because of the complexity of the design process, it is also a challenge to direct the operational knowledge to the appropriate individual or group in the design team at the right time.

"The end user is still the guy who has been stabilising rigs for years and who can actually say by a quick look in the drawings: this is not going to work."

Rig section leader

ORGANISATION OF THE DESIGN PROCESS
ENGINEERING DESIGN TEAM + SHIPYARD + VENDORS

DESIGN PHASES



S

SPACE

- Office building layout
- Location of designers from various disciplines
- Project spaces

O

ORGANISATION

- Work processes and procedures
- Project-based work
- Collaboration and coordination with shipyard and vendors

F

FINANCE

- Design cost
- Customisation costs
- Customer value

T

TECHNOLOGY

- Computer Aided Design
- ICT systems
- Databases

HOW IS THE CURRENT KNOWLEDGE TRANSFER WORKING?

DIAGNOSING CURRENT KNOWLEDGE TRANSFER

Diagnosing the current knowledge transfer in the company is the first step towards initiating improvements and integration into design projects.

Making the diagnose requires internal or external resources. It requires individuals who are capable of applying investigative methods in different parts of the company, who are aware of different work systems and are able to facilitate workshops that involve them, and who can frame and categorise challenges and requirements in order to develop a management strategy.

The knowledge transfer framework is useful in targeting your investigation, as it will enable the evaluation of the entire process of knowledge transfer that is necessary to transfer knowledge from operations to design. Accordingly, the investigation requires the participation of both work systems.

The two work systems have different tasks in the organisation, as well as different KPIs; thus, they will have different ways of generating and registering, receiving or retrieving knowledge.

You can explore means and challenges of the existing knowledge transfer system by considering the four steps of the knowledge transfer framework in your company.

CAPTURING

Work procedures are needed to track and capture activities that take place on operating rigs. On these rigs, captured knowledge is often related to incidents or accidents that are registered and analysed to improve safety and health. Systems such as these could also be used to capture knowledge that could be valuable for the design of new rigs.

TRANSFORMING

Operational knowledge should be transformed into knowledge that is meaningful for and applicable to the design. Operational knowledge can be transformed through different types of filters. These filters can be integrated as functionalities in ICT systems or could be individuals who act as filters and/or senders of knowledge across work systems.

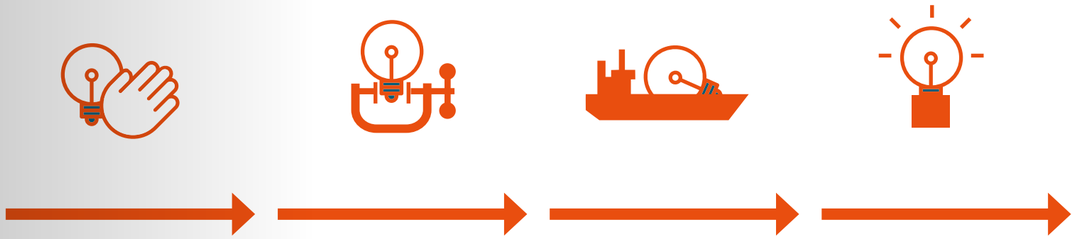
TRANSFERRING

Knowledge can be transferred through different kinds of channels. These could be ICT systems, campaigns, personal networks or communication systems. There could be certain functionalities in these systems that direct, target and send knowledge to specific organisational functions, groups or individuals.

APPLYING

Once knowledge is received or retrieved, it needs to be applied during the right phase of the design process. In order for operational knowledge to be used in the design of new rigs on an on-going basis, formal procedures need to be integrated into standard design processes.

The table illustrates some basic questions that you may ask when exploring the existing knowledge transfer process.



CAPTURING	TRANSFORMING	TRANSFERRING	APPLYING
How is knowledge captured in the operations work system?	**How is knowledge transformed into valuable knowledge for design?**	**How is knowledge transferred to the design work system?**	**How is operational knowledge applied in the design process?**
Which procedures are used to generate and capture knowledge?	What kind of filters are applied to the captured knowledge?	Through which kinds of channels is knowledge sent?	What are the incentives to apply operational knowledge in design?
What kind of knowledge is captured and registered?	How is the knowledge categorised?	What kind of mechanisms direct and target knowledge?	How is transferred knowledge used in design processes?
Is the captured knowledge design-oriented and valuable?	How is the knowledge processed in the knowledge transfer system?	Who are the senders and receivers and how do they communicate?	How is operational knowledge continuously incorporated into and applied to standard design procedures?

APPLYING METHODS FOR DIAGNOSING

“Quite often it is based on chance: you need to meet someone, talk to someone, rather than being systemised, which I think is an issue.”

Rig section leader

A combination of the following three methods can be used to diagnose the existing means and challenges in knowledge transfer.

MAP THE KNOWLEDGE LANDSCAPE

Map the knowledge landscape by identifying and listing ways of capturing, transforming, transferring, and applying knowledge from the operating rigs to the design teams.

CONDUCT WORKSHOPS

Explore challenges in knowledge transfer and their causes and effects by gathering people from both work systems in a collaborative workshop setting.

STRUCTURE CHALLENGES

Identify challenges and systematise them in relation to knowledge capture, transformation, transfer, and application in the design processes.

MAPPING THE KNOWLEDGE LANDSCAPE

To identify the means of knowledge capture, transformation, transfer and application, it can be useful to draw a knowledge map of the following:

- Means of generating knowledge in the operating rigs
- Different systems in which knowledge can be registered
- Means of registering knowledge in different systems
- Channels and systems that can transfer knowledge from the operating rigs to the design teams
- Means of filtering and tagging knowledge
- Types of knowledge that are transferred through the channels
- Means for the design team to retrieve knowledge from the systems
- Means in which the design team can receive knowledge from the channels

Be aware that the ways in which knowledge is captured, handled and shared can be either informal or formal. It is important to identify all the different means in order to create sustainable and user-friendly solutions.

In the operations (or operating rig) work system, you should identify the different departments, teams, and functional roles that generate and/or register knowledge.

- Which tools and procedures are used to capture and register knowledge?
- Which channels or systems transfer the knowledge?
- Who or what works as filters to systematise and direct the knowledge towards the design teams?

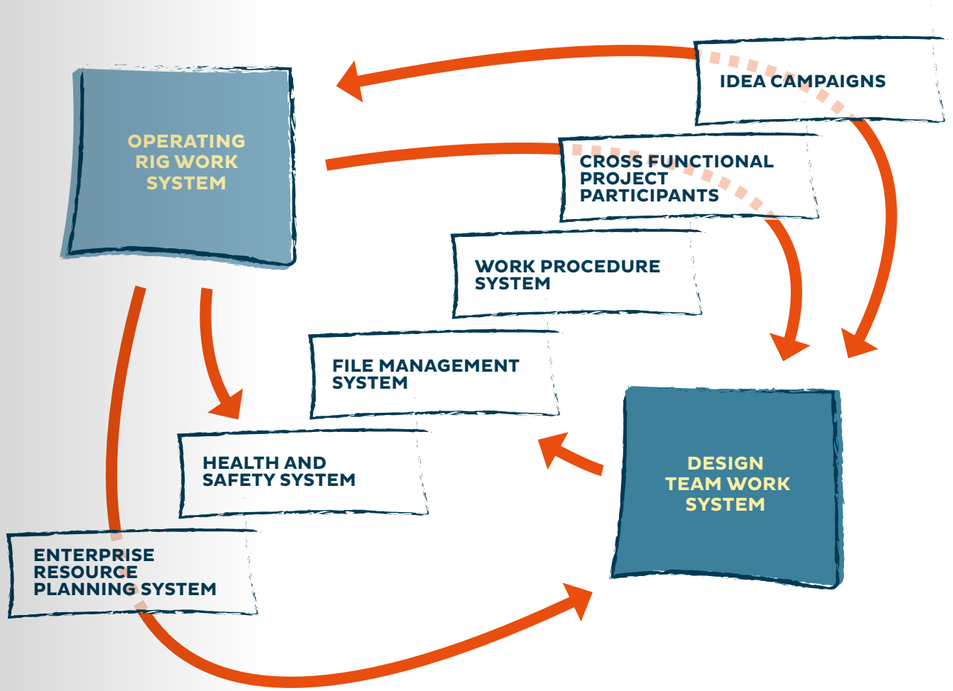
In the design (or design team) work system, one should identify how designers retrieve or receive knowledge from the operating rigs and how they apply this operational knowledge in the design process:

- What kind of strategies do designers apply to search for knowledge that could be useful when making design decisions?
- Which means or systems do designers use to track operational knowledge?
- How are designers utilising and applying operational knowledge when making design decisions?

Using the information obtained, you can map the work systems and the knowledge transfer landscape. Employ illustrative tools to draw the map. This can also be done during a workshop by using interactive and moveable map elements.

“There are a lot of systems, maybe too many, because you don’t know from where to start looking for things when you have so many databases.”

Rig worker participating in the project team



CONDUCTING WORKSHOPS

The aim of using workshops is to bring together the two work systems of operations and design that rarely meet, but which have great potential to collaborate with regard to design. Workshops allow people to explore, share and create insights in order to gain a common understanding of the existing situation and to generate suggestions for improvements via a collaborative effort.

Conducting workshops requires having the resources to plan, facilitate and document the process. The following steps are required:

- Define the purpose and intended outcomes of the workshop
- Plan and prepare tasks, activities, and the process of the workshop
- Prepare boards, cards, and other materials to be used in the workshop
- Point out a few facilitators depending on the size of the workshop
- Divide participants in bigger workshops into groups of no more than six
- Include employees and managers from both work systems in the workshop

The duration of a workshop can be from two hours to an entire working day. It can be beneficial to conduct two workshops with different aims:

1. MAPPING THE KNOWLEDGE LANDSCAPE

- Participants identify existing means of capturing, transforming, transferring, and applying operational knowledge to new designs
- Participants map the existing knowledge transfer process via cards and arrows, using illustrations of the two work systems
- Participants identify challenges, causes, and effects of transferring or not transferring knowledge between the work systems, marking them with Post-It notes
- Discuss how the knowledge transfer or the lack of knowledge transfer impacts on the design process and the phases thereof
- Summarise the main findings and suggestions in a document and distribute copies to the participants

2. IMPROVING THE KNOWLEDGE TRANSFER

- Participants discuss and identify the necessary functionalities of the knowledge transfer system
- Participants identify and suggest ways of improving knowledge transfer in four steps, namely capture, transformation, transfer and application
- Participants add suggestions to the illustration of the system using Post-It notes, cards or pins
- Suggestions can include individuals and roles, procedures and standards, or processes and technical features
- Summarise the main findings and suggestions in a document and distribute copies to the participants

“I think this workshop was pretty good. I like this interactive system where you first give ideas, and then you can build on other people’s ideas.”

Project manager

STRUCTURING CHALLENGES

Using the two methods enabled the identification of the challenges in the existing knowledge transfer system. Using the framework, you are now able to group and categorise the main challenges involved in knowledge transfer. Once the main challenges in each step of the knowledge transfer process have been structured, you will be able to set up the requirements to target potential solutions.

In the process of structuring the main challenges, you should consider the challenges in each step of the knowledge transfer process:

CAPTURING

Captured knowledge may make sense in one work system but not make sense or be considered valuable in the other. The work systems may use different technologies, procedures or systems to capture and store knowledge. Contradictory KPIs in the two work systems can cause misalignment and make it difficult to collaborate and share knowledge.

TRANSFORMING

The amount and complexity of operational knowledge can be challenging to filter and qualify for design purposes. Captured knowledge is not usually intended for design purposes and may not be seen as worth integrating into the design processes. Systems for knowledge transfer may not have the functionality to transform this captured knowledge into knowledge valuable for design.

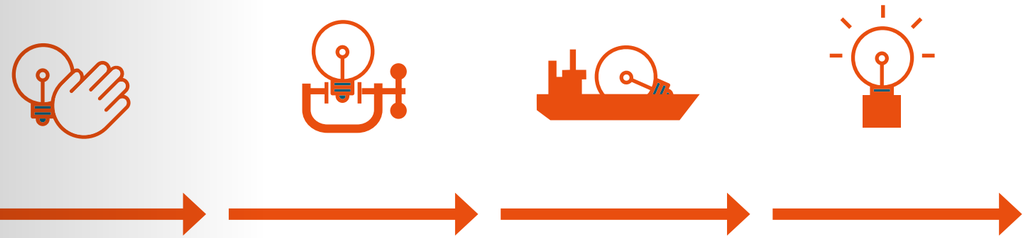
TRANSFERRING

There needs to be a management strategy that allows and provides tools for transferring knowledge from one work system to the other. Integrating knowledge from the operating rigs can be challenging if the knowledge is difficult to search for and retrieve, and if it does not provide a basis for action in the design team. Knowledge transfer may rely only on individuals or informal strategies that are difficult to track, learn from, or utilise at an organisational level.

APPLYING

Knowledge from the operating rig work system should be available and applied at the right time in the project. Otherwise, retrieved knowledge may be irrelevant or impossible to implement in terms of design specifications. Including knowledge from operations in new designs can be cumbersome in complex project organisations in which vendors and shipyards play an influential role. A formal process of knowledge transfer from project to project is necessary to avoid being highly dependent on a small number of designers who carry the knowledge with them.

The aim is not to present an exhaustive list of challenges, but to group various small challenges to form broader ones, structuring them according to the framework. The table shows examples of the main challenges that can occur in the knowledge transfer between the operating rig and the design team work systems.



CAPTURING

What are the challenges when capturing knowledge in the operating rig work system?

- Captured knowledge is not targeted or oriented towards design
- Different systems for capturing and retrieving knowledge are used
- KPIs do not encourage knowledge capture and transfer for design purposes

TRANSFORMING

What are the challenges when transforming captured knowledge into knowledge valuable for design?

- Difficult to qualify captured knowledge due to the amount and complexity thereof
- Captured knowledge is not transformed to target design activities
- Systems are not configured to transform captured knowledge for design processes

TRANSFERRING

What are the challenges when transferring knowledge to the design team work system?

- Lack of systems or management strategies for bringing in operational knowledge to design
- Difficult to search for and retrieve relevant knowledge for the design team
- Transfer of knowledge relies on individuals and personal strategies

APPLYING

What are the challenges when applying operational knowledge in the design of new rigs?

- Difficult to integrate operational knowledge into design projects at the right time
- Interaction with shipyard and vendors may limit the possibility of including operational knowledge
- No formal transfer of learnings and experiences from project to project

WHAT DOES IT TAKE TO TRANSFER KNOWLEDGE?

REQUIREMENTS FOR KNOWLEDGE TRANSFER

"We need a core group which is analysing everything in a continual basis, developing concepts that we can then park and have them ready to execute at the point we get a requirement specification."

Rig worker participating in the project team

It is now time to understand what it takes to face the challenges identified and to improve the process.

It is important to set up the main requirements for creating an improved system for knowledge transfer. These should include a management strategy to deal with the entire knowledge transfer process, focusing on the interaction between the two work systems.

The overall requirements for knowledge transfer should lead to solutions to the challenges identified. You should note the main causes and effects of each challenge in order to develop requirements and solutions for them. This should be done for all the main challenges in order to define an action and implementation plan to improve the knowledge transfer process.

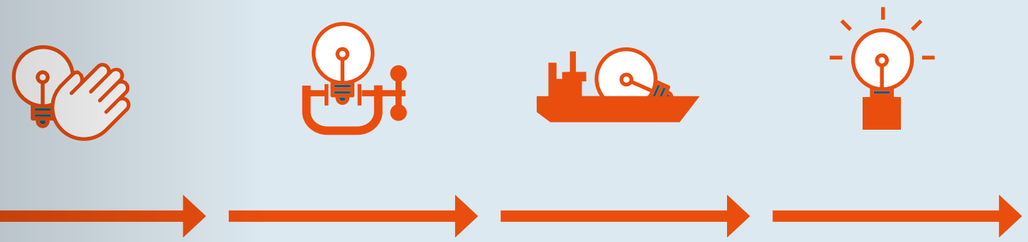
A simple template can be used to facilitate developing and structuring the requirements for the system, as well as to systematise an overall action plan to improve knowledge transfer.

The focus should be on having the same system on both work systems, as well as on having clear procedures and standards to capture the operational knowledge. Make sure to align the KPIs related to the knowledge transfer process, what will allow for better collaboration and communication between the two work systems.

Challenge	Different systems for capturing and retrieving knowledge
Possible causes	Offshore and onshore work systems are not using the same formal ICT system
Possible effects	Knowledge is registered but never retrieved, since the design team does not access the same system
Solution requirements	Establish one clear system to be used by both work systems
Possible solutions	The same ICT system for both work systems, with capturing tags, and standards aligned with search and retrieval features
Action plan	Who does what when to implement the solution?

You should also consider clear methods and resources to systematise and transform the knowledge, together with appropriate methods to make it available to the design team.

The knowledge transfer framework also helps to frame the requirements, systematising them according to capturing, transforming, transferring and applying knowledge.



CAPTURING

What are the requirements for capturing knowledge in the operating rig work system?

- Focus on capturing knowledge relevant for the design of new rigs
- Establish one clear system to capture knowledge, including standards for the process
- Consider setting KPIs that encourage the knowledge from the rigs to be shared

TRANSFORMING

What are the requirements for transforming captured knowledge into knowledge valuable for design?

- Define methods to filter and qualify the captured knowledge
- Transform and systematise this knowledge in order to make it valuable for designers
- Consider allocating dedicated resources to handle the knowledge transformation

TRANSFERRING

What are the requirements for transferring knowledge to the design team work system?

- Define systems and strategies allowing and providing tools for bringing operational knowledge into design
- Focus on a user-friendly system with search possibilities for retrieving knowledge
- Use standards and clear procedures for transferring knowledge, and avoid relying mainly on personal strategies

APPLYING

What are the requirements for applying operational knowledge in the design of new rigs?

- Establish a process during the design project whereby knowledge can be retrieved and used at the right time
- Consider sharing the operational knowledge with the shipyard and the vendors, thus increasing the possibility of including it in the design
- Set up a formal process of lessons learned from one project to another, thus ensuring that the transferred knowledge can be re-used in different projects

THE FOUR-STEP KNOWLEDGE TRANSFER MODEL

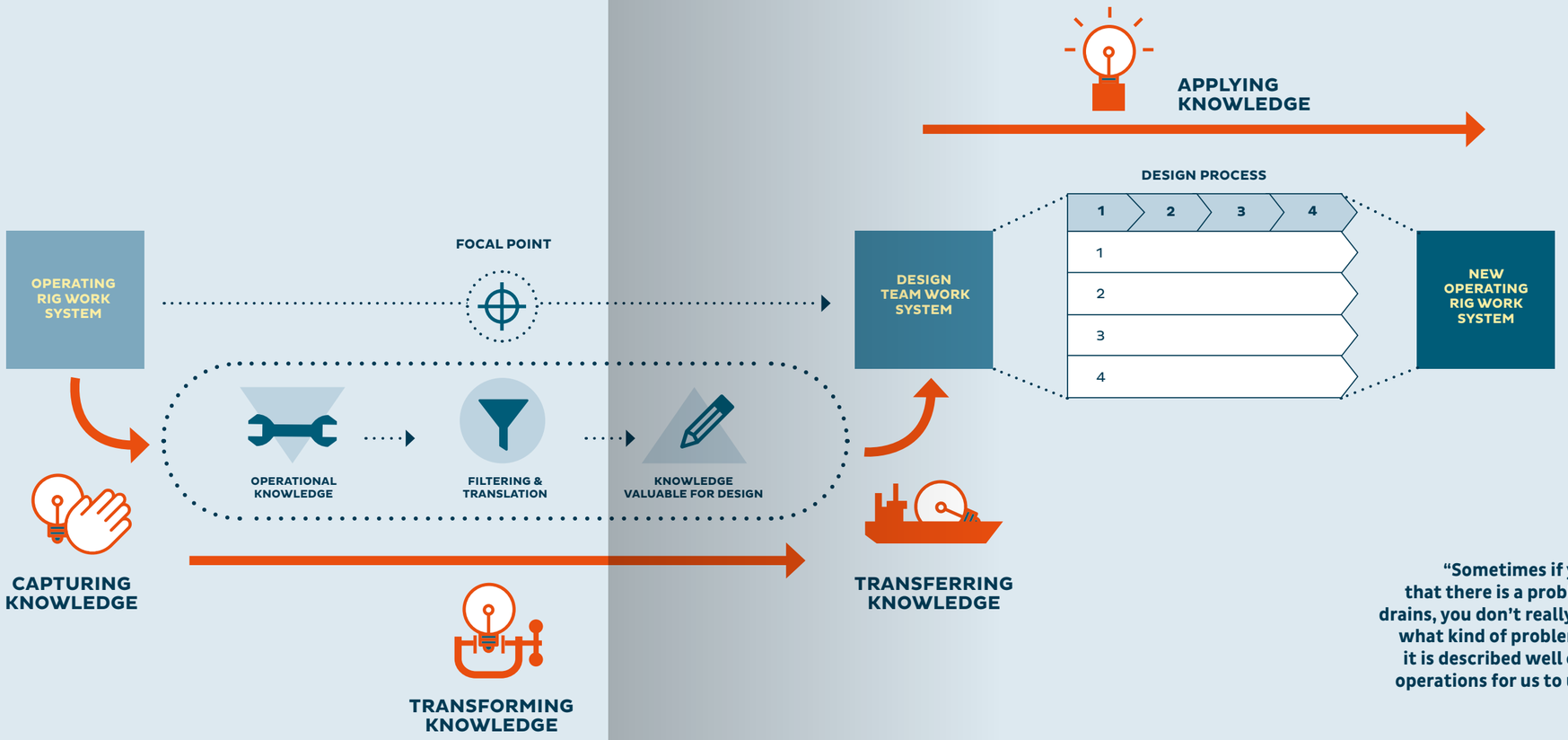
Consider an apparently simple problem that results in further problems and increased working hours on the rig:

Drains are needed everywhere on the rig, but they might not always be in the right positions or may not have pipes allowing for proper drainage.

How is this communicated to the designers?

How would you solve the issue with the drains? How would you ensure that knowledge from operations arrives to the design team?

The four-step knowledge transfer model assists by structuring the knowledge transfer process to address these questions. This process is explained in the next pages. You will find tools, methods and ideas regarding how to implement it, as well as a case exemplifying the entire process.



"Sometimes if you just hear that there is a problem with the drains, you don't really understand what kind of problem it is unless it is described well enough from operations for us to understand."

Design engineer

CAPTURING KNOWLEDGE

WHAT TO CONSIDER

- What types of knowledge are relevant for the design team?
- Which formats should be used to capture knowledge?
- What kind of knowledge does the design team need?
- How do you start to qualify and categorise the captured knowledge?

TWO TYPES OF KNOWLEDGE SOURCES

Rig workers' experiences:
- Needs
- Problems and limitations
- Ideas and benefits
- Good solutions to be retained

Operational data in ICT systems:
- Relevant data
- Equipment performance and maintenance
- Change projects
- Down-time reports

WHAT DO YOU NEED IN ORDER TO CAPTURE THIS KNOWLEDGE?

- Standards for capturing and registering knowledge, meaning you should establish formal ways of capturing operational knowledge
- Direct flow of ideas, meaning you should plan how this knowledge will be handled once it is in the system to prevent losing it

How to capture operational knowledge in the operating rig work system?

The aim here is to have the various problems and ideas registered within defined categories and stored in an inventory.

WHAT TO CONSIDER?

The way in which knowledge that is relevant to design is gathered may differ depending on the type of knowledge. There may be ideas for improvements, reports on problems, permanently registered maintenance and performance data, and so on.

Knowledge can be captured using formats such as paper templates, spreadsheets, tablets, straight onto ICT systems or via e-mails.

However, regardless of the format, it is a good idea to allow for the inclusion of pictures, drawings or any other images that help to clarify the ideas or the problems encountered.

The way rig personnel register ideas or report problems will make a difference. They should always be asked to reflect on the limitations the problems are causing and the benefits of their ideas. This will enable the design team to better evaluate the existing options to fix the problems and to determine whether they are viable.

An initial filter on the rig of the existing ideas and reports may be an option. Section leaders or team supervisors are usually able to take on this role and can begin to qualify and categorise this knowledge in terms of relevance to the design of new rigs.

HOW TO DO IT?

Permanent idea campaigns

A permanent and direct link on which rig personnel can register their ideas and provide input could be created using a specific system that directs ideas to the appropriate people, who will then filter and consider them.

Capture cards

Providing a simple template that the personnel on the rigs can use to register their ideas regarding improvements or concerns about problems via a few simple questions will lead the individuals to reflect upon knowledge that could be valuable for the design team. These cards can be filled out by everybody on the rigs, at any time, and can be registered on the system afterwards by section leaders or team supervisors.

Mandatory system tags to start categorising the knowledge

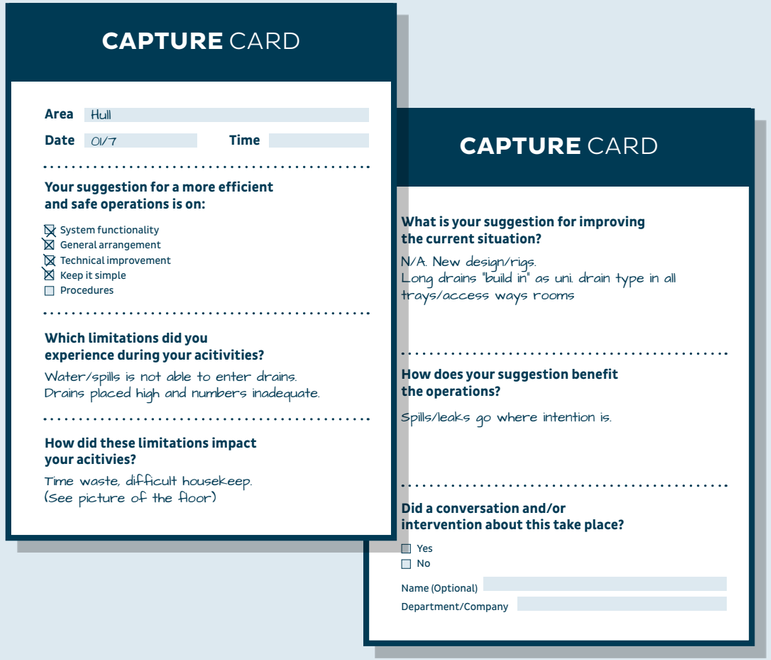
When registering reports or ideas on systems, you may consider some features that will make it easier to keep track of all this knowledge. Limiting free text makes it easier to search for and filter it afterwards. Furthermore, it is important to define certain mandatory tags/objects in the system that will make it easier to retrieve the knowledge.

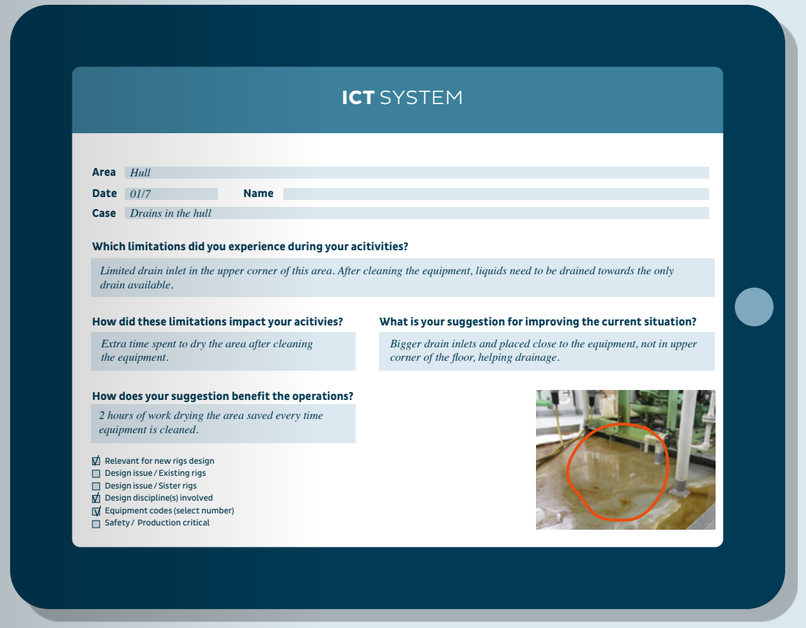
WHOM TO INVOLVE?

The main actors involved at this stage are all personnel on a rig who can potentially contribute by providing inputs or ideas regarding the design of new rigs, as well as the section leaders and team supervisors, who can also perform the initial filter of the knowledge captured.

CAPTURE CARDS

The main idea behind the questions on these cards is to encourage rig personnel to report: 1) the limitations created by the problems they encounter, and/or 2) the benefits that would result from a suggested idea for improvement. This would make it easier to understand their points and to look at the possibility of implementing suggestions when possible. Another option is to ask them to classify their ideas.





MANDATORY SYSTEM TAGS

The main idea behind these tags is to direct each idea or report to the appropriate designers, or to make it easier for them to retrieve it. When registering ideas on the system, section leaders or team supervisors have the knowledge to identify whether a suggestion is only applicable to that rig, to all sister rigs, or is also relevant to the design of new rigs. Other tags are of similar importance, such as equipment codes or whether an idea is crucial for safety or production.

TRANSFORMING KNOWLEDGE

WHAT TO CONSIDER

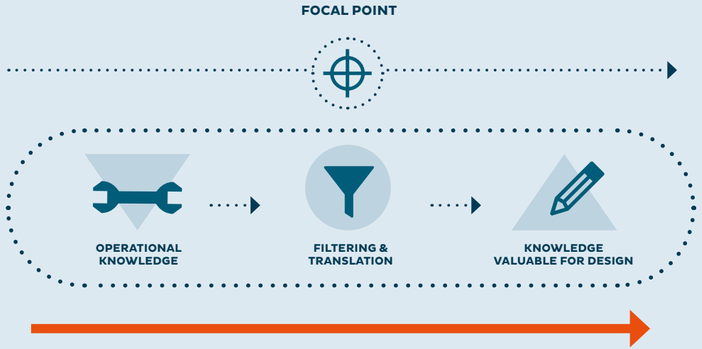
- What kind of ICT system should be considered to handle the process?
- How to filter and prioritise the captured knowledge?
- What to include in the knowledge descriptions to make them more valuable for designers?
- What type of feedback should be given to the source of the captured knowledge?

RESOURCES WITH DIFFERENT FUNCTIONS

Filters and focal points:
- Gathering operational knowledge to categorise and prioritise
- Contacting rigs for more information when needed
- Directing the knowledge to the designers

WHAT DO YOU NEED IN ORDER TO TRANSFORM THIS KNOWLEDGE?

- Qualified filtering and handling of captured knowledge, meaning you should consider categorising this knowledge and making it searchable according to rigs' areas and design disciplines, for example
- Knowledge available to all and easy to search for and retrieve, meaning you should provide an inventory with user-friendly features in which all captured knowledge can be accessed



How to transform the captured knowledge from the operating rig into knowledge valuable for design?

The aim here is to be able to transform the knowledge that has been captured and stored. It needs to be filtered and qualified in order for it to be translated into valuable knowledge for the design team.

WHAT TO CONSIDER?

You should consider ways of handling all the knowledge captured, and having one main system to gather it and work as an inventory. Having different systems makes the entire knowledge transfer process more complicated and makes it difficult to retrieve the knowledge at a later date.

Despite the first filter and qualification steps when the knowledge was registered on the system, it is still necessary to have a specific design-qualified filter to be able to prioritise knowledge that is valuable in terms of the design of new rigs. This qualified filtering requires specific resources and can also work as a focal point when organising the inventory.

You should also consider the form in which this knowledge would be available to the designers. Due to the amount of knowledge designers need to process, they seek concise information. Prioritising short descriptions instead of long explanations is a good starting point, and including not only numbers and statistics, but also pictures and drawings.

Providing feedback to the rig personnel regarding their ideas and inputs should also be considered. Knowing whether an idea was accepted or, if not, why it was rejected keeps people motivated to share more knowledge.

HOW TO DO IT?

ICT system inventory with search and retrieval features

One good option for storing the captured knowledge is an ICT system inventory used both in the operating rig work system for capturing and registering knowledge and in the design team work system to search for and retrieve this knowledge.

Dedicated personnel as filters and focal points

When handling the captured operational knowledge, you may consider having dedicated personnel working as filters and/or focal points to transform the knowledge. Such individuals will need to be qualified in design, thus enabling them not only to sort and prioritise the knowledge registered on the system, but also to categorise and direct this knowledge to the relevant design disciplines. These individuals would also function as a connection between the two work systems, contacting the rig to clarify the captured knowledge when necessary and serving as a focal point to direct aspects of this knowledge to the designers, based on the priorities and categories.

WHOM TO INVOLVE?

The main actors involved in this stage are dedicated personnel with qualifications in design who will interact with section leaders and with design team members.

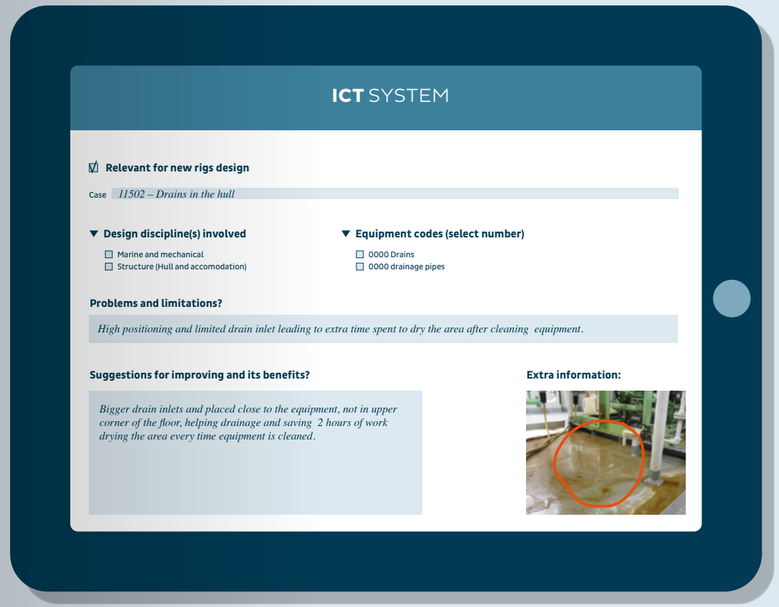
ICT SYSTEM INVENTORY WITH SEARCH AND RETRIEVAL FEATURES

The main idea behind an ICT system inventory is to facilitate the flow of inputs and ideas from one work system to the other. Having one main system inventory helps with implementing tags and standards when capturing knowledge that are aligned with search and retrieval features.

VALUABLE KNOWLEDGE FOR DESIGN

The captured operational knowledge needs to be transformed into valuable knowledge for designers, including:

- Limitations experienced during work activities
- Observations of equipment functioning
- Ideas for new designs and the benefits thereof
- Design recommendations or guidelines
- Requirements for design specifications



DEDICATED PERSONNEL AS FILTERS AND FOCAL POINTS

The main idea behind having dedicated personnel to handle the knowledge in the systems is to add the possibility of qualifying and systematising it. Capturing and registering the knowledge via tags on the system helps to structure it; however, there is also a need for a structure based on the design process and the various designers who need access to the knowledge. This facilitates searching for and retrieving the knowledge at a later date.

TRANSFERRING KNOWLEDGE

WHAT TO CONSIDER

- How should knowledge be categorised and directed to the relevant designers?
- Which formats make it easier to search for and retrieve knowledge?
- Which channels should be used to transfer this knowledge?
- How to connect the source of the knowledge and the receiver?

KNOWLEDGE VALUABLE FOR DESIGN

DESIGN TEAM WORK SYSTEM

INVENTORY WITH SEARCH AND RETRIEVAL FUNCIONALITIES

Bank of ideas and problems encountered:

- As many tags as possible, making it easier to search for and retrieve
- Prioritising the knowledge most important for design
- Notifications of prioritised knowledge for the relevant designers

WHAT DO YOU NEED IN ORDER TO TRANSFER THIS KNOWLEDGE?

- Knowledge should be qualified and searchable, meaning you should provide it in appropriate formats and categories that designers can search for and retrieve
- Clear procedures for transferring knowledge, meaning you should define a clear structure to store knowledge and to make use of it during the design process

How to transfer the transformed operational knowledge to the design team?

The aim here is to be able to transfer the filtered and qualified operational knowledge to the design team. This knowledge must be available to be searched for and retrieved by the designers, while the prioritised knowledge should be directly sent to the appropriate designers.

WHAT TO CONSIDER?

The operational knowledge has been transformed and should also be categorised and directed to the appropriate designers. Having categories based on the rig type, the rig area or even the design disciplines involved makes it easier to direct this knowledge to the designers.

You should also consider which formats make it easier for the designers to receive, or search for and retrieve the knowledge. A knowledge inventory on an ICT system may work as a bank of ideas and problems encountered on rigs that allows designers to access knowledge at any time.

The channels used to transfer knowledge should also be considered. Knowledge can either be transferred via ICT system channels or carried by individuals across the boundaries between the operating rig and the design team work systems.

Apart from different channels, you may also consider having a direct link between the senders and the receivers of the knowledge. This link may work by pulling knowledge from the operating rig work system or by pushing it to the design team work system.

HOW TO DO IT?

Knowledge inventory and system notifications

When having a knowledge inventory on an ICT system, you may consider including some features that direct the knowledge to the relevant designers via system notifications. After qualifying and prioritising the knowledge, the designers directly involved with a problem or an idea registered on the system could receive notifications of new inputs, making it easier for them to be kept informed regarding new inputs in their areas of expertise.

Focal agents as direct links from senders to receivers

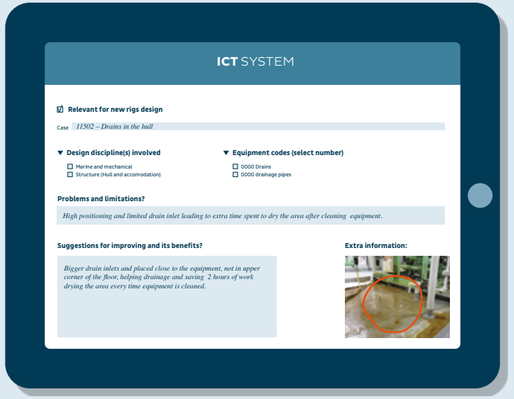
Having a direct link from the senders to the receivers of the knowledge avoids having too many steps between them and decreases the risk of the knowledge being lost. A focal agent, who may also have transformed the knowledge previously, works as a gate keeper and ensures the right knowledge reaches the right designers.

WHOM TO INVOLVE?

The main actors involved at this stage are the design team members and managers, as well as the dedicated personnel who are qualified in design and who work as focal agents.

KNOWLEDGE INVENTORY AND SYSTEM NOTIFICATIONS

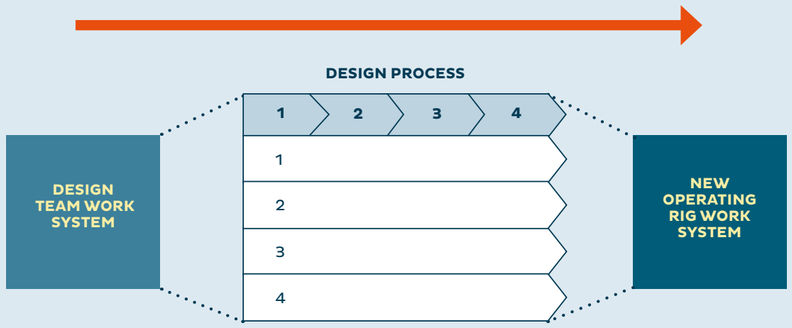
The main idea behind having a knowledge inventory is to ensure all the knowledge is available and can be retrieved when a designer needs it. However, the relevant designers may receive direct notifications from the system regarding new inputs, which speeds up the process of identifying new ideas that have been registered.



FOCAL AGENTS AS DIRECT LINKS FROM SENDERS TO RECEIVERS

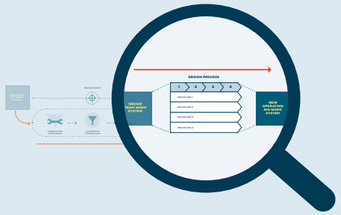
The main idea behind having focal agents is the possibility of having direct links between the operating rig work system and the design team work system. These individuals connect the two work systems and ensure the relevant knowledge reaches the relevant designers instead of being lost in the system.

APPLYING KNOWLEDGE



WHAT TO CONSIDER

- When should knowledge be available for designers in order for them to apply it?
- How to ensure that the appropriate knowledge reaches the right designers?
- How to ensure knowledge is shared with external partners and applied in the design?
- How to create a feedback loop to share knowledge from project to project?



INTERNAL AND EXTERNAL ACTORS

Different actors and different roles:

- The design team is the main agent responsible for the design of new rigs
- The rig personnel are often asked to comment on design drawings and specifications or to collaborate on an entire project
- The vendors have individual standards that may differ from incorporating operational knowledge into the design
- The shipyard team will be responsible for the detailed design and the construction of the new rig

WHAT DO YOU NEED IN ORDER TO APPLY THIS KNOWLEDGE?

- Integrated standards and design procedures, including the use of transferred knowledge, meaning you should include the application process in the formal procedures by also including the shipyard team and vendors
- Formal process for sharing the lessons learned from project to project, meaning you should define clear procedures to incorporate the knowledge transferred also in future projects, including the review process of technical specifications

How to apply the transferred operational knowledge in the design of new rigs?

The aim here is to be able to apply the transferred knowledge in the design of new rigs. You need the right knowledge at the right phase of the design process in order to apply it and optimise the design of new rigs.

WHAT TO CONSIDER?

Having an inventory helps to ensure that the knowledge will be available when the designers need it. Since the design process is complex and iterative, different types of knowledge may be needed at different times; thus, ensuring the designers have access to knowledge when they need it increases the possibility of applying this knowledge.

Specific designers will need specific knowledge depending on the design discipline for which each designer is responsible. Not every problem or idea reported on the system will be relevant to all the designers. It is important to avoid an overload of information.

It is also important to ensure that the transferred knowledge reaches the external design partners. Since vendors and shipyard teams play decisive roles in the design process, sharing this knowledge with them increases the chance of applying the knowledge.

When completing a project, sharing lessons learned for new projects should also be considered. A feedback loop with lessons learned will ensure the operational knowledge transferred will remain on the agenda for future projects.

HOW TO DO IT?

Right timing and right people

When determining the right phase of the process and targeting specific individuals or functions in the project teams, you must ensure the knowledge is available when it is needed. It is important to ensure operational knowledge does not reach the design team when the process is too advanced to incorporate changes. Furthermore, the individuals who need to be involved to address the challenges should also be considered.

Design standards and guidelines

When applying the transferred knowledge in a specific project, it is important to ensure it will be remembered the next time. Establishing standard design guidelines that would continue to be updated as new operational knowledge is integrated is paramount in order to avoid repeating past mistakes.

Feedback loop between projects

Sharing the lessons learned from finished projects via a feedback loop ensures that knowledge is not lost. Thus, establishing formal procedures to update the lessons learned in terms of specifications and making them available to new design teams should be considered.

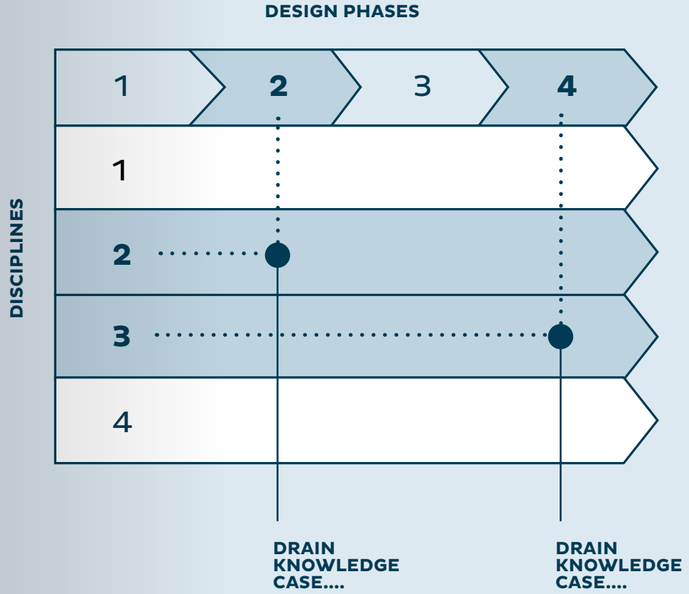
WHOM TO INVOLVE?

The main actors involved at this stage are the design team members and managers, as well as rig personnel taking part in projects, vendors and the shipyard team.

RIGHT TIMING AND THE RIGHT PEOPLE

The main idea behind targeting the right time and the right individuals within the design process is to avoid unnecessary overload and to ensure the knowledge reaches the relevant designers when they need it. Furthermore, during the design process, rig personnel are usually asked to take part in the process. It is important to ensure this does not happen too late in the process and that the right people are called in from the operating rigs.

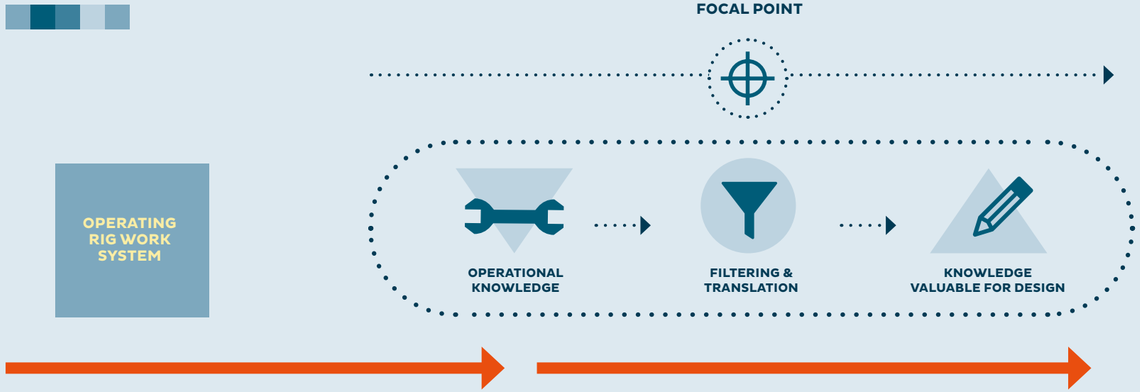
DESIGN PROCESS



DESIGN STANDARDS AND GUIDELINES

The main idea behind establishing procedures to maintain updated design standards and guidelines is to ensure that knowledge is not lost from one project to another. This will also help to reduce the designers' workload in terms of retrieving relevant knowledge, since they would only need to search for new inputs on the system.

TOOLS AND METHODS BEHIND THE FOUR-STEP MODEL



CAPTURING KNOWLEDGE

To standardise the capture and registration of operational knowledge:

- Permanent idea campaigns
- Capture cards
- Mandatory system tags to start categorising the knowledge

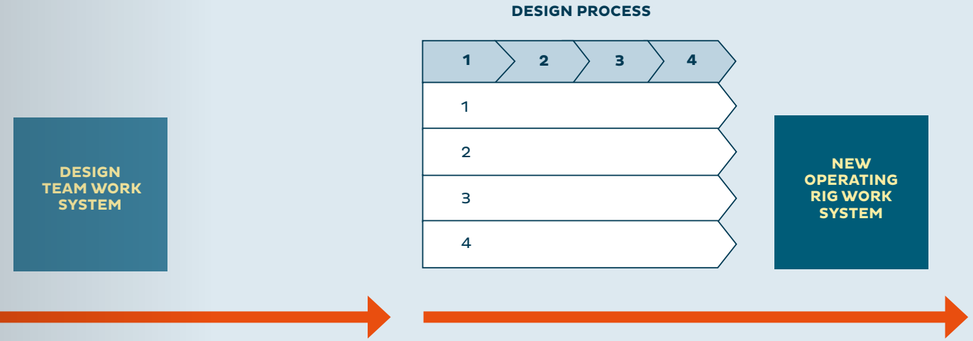
TRANSFORMING KNOWLEDGE

To structure the transformation of operational knowledge into knowledge that is valuable for design:

- ICT system inventory with search and retrieval features
- Dedicated personnel as filters and focal points

"So if we get these people in before we make decisions, we can save time and it will be easier to implement."

Rig worker participating in the project team



TRANSFERRING KNOWLEDGE

To facilitate the transfer of knowledge that is valuable in terms of design from the operating rig to the design team work system:

- Knowledge inventory and system notifications
- Focal agents as direct links from senders to receivers

APPLYING KNOWLEDGE

To structure the application of operational knowledge in the design of new rigs:

- Right timing and right people
- Design standards and guidelines
- Feedback loop between projects

This booklet is the outcome of a two-year research project on knowledge transfer from the operations of oil rigs into the design of new rigs, with results that can be generalised for other sectors within the maritime industry.

The research project was carried out at DTU Management Engineering and funded by the Danish Maritime Fund. This research was conducted in collaboration with a company working in the oil sector.

Authors
Carolina Souza da Conceição / casou@dtu.dk
Anna Rose Vagn Jensen / anrvj@dtu.dk
Ole Broberg / obro@dtu.dk

Technical University of Denmark
DTU Management Engineering

September 2016

You can find this booklet and the scientific outcome of the project at www.edgeproject.dk

DTU
Engineering Systems
Department of Management Engineering

DEN DANSKE
MARITIME FOND